Methods to Manage

Mistletoe

A Landholder's Guide

Acknowledgements

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Disclaimers

Although various chemical products and methods are mentioned in this publication, this should not be taken as an endorsement.

Note that the *Native Vegetation Act 2003* in NSW does not allow the removal of mistletoes as a permitted activity, since all mistletoes in NSW are native plants. Mistletoes are also a vital resource for several threatened species in certain parts of the state. Therefore wilful damage of mistletoes may also contravene the *Threatened Species Conservation Act 1997.* Landowners in NSW are advised to consult their local CMA, and if necessary, seek legal advice, when planning vegetation interventions involving mistletoe on their farms.

Contents

What are mistletoes?

Australian mistletoes are flowering plants that grow as semi-parasites capable of photosynthesis but dependent on their hosts for water and minerals.

Instead of roots, mistletoes use woody organs, called 'haustoria', to extract water and nutrients from host trees.

The aerial portions of mistletoe are leafy, evergreen clusters of shoots which contain chlorophyll and are generally green in colour though often with yellowish, brown or olive tints, especially in winter.

The Australian mistletoe flora comprises 74 species (12 genera) of Loranthaceae and 16 species (3 genera) of Viscaceae (Reid & Yan 2000). All are native plants.

Mistletoes tend to be restricted in the range of hosts they will colonise, and often have foliage that mimics that of the preferred host plants.

Loranthaceous mistletoes occur in a wide variety of wooded habitats including eucalypt forests and woodlands in Australia.

Box mistletoe (*Amyema miquelii*) is the most widespread and abundant species on eucalypts in northern New South Wales (NSW).

Drooping mistletoe (*A. pendula*), long-flowered mistletoe (*Dendrophthoe glabrescens*), golden mistletoe (*Notothixos subaureus*) and jointed mistletoe (*Korthalsella rubra* ssp. *geijericola*) are some of the other mistletoes that cause concern in this region.

Many other mistletoes occur in our region but rarely if ever achieve pest status.

It was observed in ancient times that mistletoe would often appear on a branch or twig where birds had left droppings.

'Mistel' is the Anglo-Saxon word for 'dung', and 'tan' is the word for 'twig'. So, mistletoe means 'dung-on-a-twig'.

(Williams, n.d.)

Mistletoe: friend or foe?

Mistletoes have succulent and nutritious leaves and fruits, and loranthaceous mistletoes have showy nectar-rich flowers. They are food plants for a broad range of animals, birds and insects (Reid 1986; Watson 2002).

For example, possums and gliders eat mistletoe foliage, fruits and flowers. Therefore, where possums and gliders are abundant, mistletoe populations are held in check.

Honeyeaters (Meliphagidae) use the flowers for nectar. Butterflies such as the azure (Lycaenidae: *Ogyris* spp.) and white butterflies (Pieridae: *Delias* spp.) lay their eggs on mistletoe leaves and the larvae can defoliate mistletoes (Reid 1995).

A species of fruit fly (*Cerapitella loranthi*) lays its eggs in mistletoe fruits and can destroy the fruit crop.

Mistletoes also provide important nesting resources, directly as nest sites and indirectly via hollow formation (Watson 2002).

Areas of forest, woodland and shrubland with mistletoes tend to have more species of animals (Bennetts *et al.* 1996; Turner 1991).

Many people in the agricultural districts of southern and eastern Australia are concerned about the death and debility of trees due to mistletoe infestation (Reid 1997).

Are mistletoes a problem?

Mistletoes tend to occur most abundantly on the edge and margins of remnant vegetation in rural areas, and on isolated trees.

There are many instances of box mistletoe occurring in high densities on dying eucalypts. Experiments confirm that these mistletoes can kill their host.

But most mistletoes do not kill their hosts, as this would lead to their own demise. In most cases, both mistletoe and host seem to be able to live together without undue effect on each other. Sometimes, most or all mistletoes die on their host tree as a result of drought, insect attack or some other factor.

Mistletoe infection reduces host growth rates. Nicholson (1955) observed that red box (*Eucalyptus polyanthemos*) with an average crown infection of 38% had a 55% reduction in stem diameter increment. Trees with an average crown infection of 15% had an 11% reduction in radial increase.

Eucalypts can be targeted by foliage defoliating insects. Often trees are unable to recover from chronic defoliation, causing death of both host and mistletoe.

In most cases, an imbalance between mistletoes and hosts causes the death of both hosts and mistletoes. For example, overgrazing of eucalypt foliage by koalas (*Phascolarctos cinereus*) leaves the mistletoe untouched (Grund 2002) and thus mistletoe becomes a dominating member of the association.

Reid *et al.* (1994) reported that infected Blakely's red gum (*E. blakelyi*) trees (mean crown infection of 59%) were more likely to survive after mistletoe removal than matched control trees.

However, it is not unusual to find mistletoes dead on a living tree.

In parts of England and Wales, farmers would give the Christmas bunch of mistletoe to the first cow that calved in the New Year.

This was thought to bring good luck to the entire herd.

(Williams, n.d.)

The need for a balance

A balance between mistletoes and eucalypts creates an ecologically healthy landscape without undue tree stress. Natural predators of mistletoes include butterfly larvae, moths, wasps, parrots and arboreal marsupials, and these contribute to the biological control of mistletoes in natural systems.

Fire (Platt 1993) also controls mistletoes. Hyperparasitism (a mistletoe parasitising another mistletoe) may control pest mistletoes in certain situations (Pundir 1981).

It is important to retain more trees of varying age in the landscape, particularly a healthy population of vigorous younger trees, to help spread the pressure of mistletoe infestation. Platt (1993) stated that severe infestations of mistletoe are often associated with stressed or aging host trees.

It is reasonable to consider controlling mistletoes when host trees are covered in mistletoes and are stressed. There are short-term and long-term control options. Short-term control mainly involves mechanical, biological and chemical methods, while long-term control involves silvicultural methods and landscape management.

NSW Native Vegetation Act & Mistletoes

The Native Vegetation Act 2003 (NVAct) must be considered when undertaking any activity in native vegetation, or which may affect individual native plants. Mistletoes in Australia are all native species, and must be considered in relation to the NVAct. A regrowth exemption may be applied, where individual plants are being removed by a method previously used (such as lopping), in an area where this method has been used, and only affecting those individuals that have grown since 1st of January 1990 (1st January 1983 in the Western Division). Any clearing outside these directions requires an approval in the form of a Property Vegetation Plan arranged through the agency that administers this part of the NVAct.

Approval to remove mistletoes may also be required from the Department administering the Threatened Species Conservation Act 1997 (TSCAct). An approval under the TSCAct may limit the extent or number of mistletoe plants that may be cleared so that the populations of threatened species that are dependent upon the mistletoe are not affected.

How to control mistletoes

Short-term controls

Mechanical control

Lopping is an option to control mistletoes but is labour-intensive and expensive. Cutting the infected branch below the point of mistletoe attachment in order to completely remove the haustorium is effective.

Lopping box mistletoe from heavily infested Blakely's red gum and yellow box (*E. melliodora*) requires a follow-up treatment because many seedlings can be present on the trees and are not obvious at the time of cutting (Reid *et al.* 1994). Lopping is impractical where broad-acre treatment is needed, and mistletoes which have multiple, often widely spaced, haustoria may be difficult to treat by this method (Reid & Yan 2000).

Pollarding involves removal of the canopy, leaving the main limbs and trunk to re-shoot. Pollarding was trialled in South Australia as a means of treating box mistletoe on road side mallee eucalypts (Rudd 1990).

Landholders near Armidale, NSW, have pollarded Blakely's red gum and yellow box infected by box mistletoes, and reported less than 5% host deaths despite the severity of the treatment (Reid & Yan 2000).

In rural Australia where landholders wish to retain trees, pollarding may be the most cost-effective means of treating heavily infected eucalypts. However, pollarding is also labour-intensive and impractical when many trees require treatment.

A blowlamp-type weed burner (with a 75-cm flame, 1100°C) was successfully used in South Australia to control low box mistletoe on mallee and gums (Anon. 1949). Kelly *et al.* (1997) reported that box mistletoe and drooping mistletoe are sensitive to burning and slow to recover.

'Flame throwers' were tested in 1947 near Canberra, but the approach was not promising for unstated reasons. Small flame throwers of the kerosene weed burner type are not likely to be popular for mistletoe control because the flame is small (up to 3 m) and the approach offers no advantage over surgical methods.

Military style flamethrowers may have practical application for treating severe infestations, however trials are required to evaluate the cost-efficacy of this method in heavily infected trees on a commercial scale.

Biological control

Viscum loranthi was found to hyperparasitise and control *Scurrula cordifolia* in India (Pundir 1981). Khan (1993) suggested that harlequin mistletoe (*Lysiana exocarpi*) could be used to control box mistletoe in the Clare Valley, South Australia. *Notothixos* species (*Viscaceae*) are often seen parasitizing various *Loranthaceae* mistletoes throughout the northern inland of NSW.

Since Australian mistletoes have become pests within their normal geographical range, natural predators and control agents have presumably declined in abundance or efficacy. Long-term mistletoe control strategies may need to provide opportunities for formerly abundant predators such as brushtail possums or hyperparasites such as harlequin or golden mistletoe.

The reintroduction of common brushtail possums to control box mistletoe in Pitchi Ritchi Pass in South Australia in the 1940s failed because of lack of habitat for the animals (Coleman 1949). In general, the habitat for such animals is still declining in rural Australia.

Chemical control

During the 1940s and 1960s, it was observed that mistletoe was more susceptible to 2,4-D than eucalypts, and that it could be sprayed at appropriate doses without damaging the host tree. Since then, both sprays and stem injections have been used with varying degrees of success.

Rudd (1990) found that the use of 2,4-D

Kissing under the mistletoe is first found associated with the Greek festival of Saturnalia and later with primitive marriage rites. Mistletoe was believed to have the power of bestowing fertility, and the dung from which the mistletoe was thought to arise was also said to have 'life-giving' power.

(Williams, n.d.)

Is chemical control an option?

There is potential for aerial (helicopter) herbicidal control of mistletoe in scattered paddock trees. There is also potential to control mistletoe through stem injection of infected trees. However, costs can be prohibitive.

Early Australian work focused on 2,4-D because of selectivity between box mistletoe and eucalypts.

Tornado® (2,4-D Na) has proven to be most effective with minimal effects on the host tree in red gum and yellow box saplings, but is not registered for use in NSW.

sprays on box mistletoe in South Australia resulted in poor control and off-target damage. Ground spraying with 2,4-D was effective in the 1940s and 1950s but fell from favour, presumably as a result of the lack of precision, and the amount of chemical and drift. However, during the early 1990s on the Northern Tablelands, an informant said that spray drift of 2,4-D (amine salt) killed *Amyema* spp without harming the host eucalypts during aerial spraying of weeds in a crop.

Minko & Fagg (1989) tested trunk injections with glyphosate and triclopyr (ester) to control box and drooping mistletoe on eucalypts in Victoria. They recorded an average mistletoe kill of 57% for no host mortality.

The trunk injection method requires smaller amounts of chemical than spraying but the method is not suitable for heavily infected trees (Greenham & Brown 1957). It is also less attractive for large scale operations because of the labour involved and the fact that treatment may take 2 years to be fully effective (Greenham & Brown 1957). Young mistletoes are also less susceptible than older plants.

Recently, the University of New England tested a range of herbicides on box mistletoe infestations at "Merilba", near Kingstown, NSW. The results of the ground and aerial spraying treatments will be known shortly (Nick Reid, pers. comm.).

Long-term controls

Long-term control aims to create a healthy environment to reduce tree stress. Silvicultural management as a long-term control method can be economically practical (Hawksworth & Wienes 1996).

Landscape management

Management of rural landscapes in which mistletoes are over-abundant involves:

- Increasing tree cover to optimal levels, to allow for natural attrition due to mistletoes, dieback, lightning strike, storms and so on. Increasing tree cover can be achieved by natural regeneration or planting. Regeneration or revegetation with trees will shade some of the mistletoes on isolated and edge trees and help compensate for tree losses. Revegetation by natural regeneration may be the most effective solution for landholders, although survival of individual infected trees is not guaranteed. Encouraging the growth of native understorey plants and native groundcovers can be beneficial because these provide the habitat and nectar sources for insects that help control mistletoes.
- Selecting seed from mistletoe-resistant tree and shrub species or varieties for revegetation in areas where mistletoes are abundant, is smart.
- Restoring and rejoining small remnants with larger ones using corridors of native vegetation allows movement of animals that are natural control agents.
- Using low-intensity fires to kill low hanging mistletoes allows the eucalypts to survive. Fire can also be used to manage undesirable pasture species and unpalatable woody shrubs.

In most cases, it will be best to keep an appropriate level of host trees and understorey cover in the landscape to let mistletoe and animals perform their natural functions in creating a healthy, diverse, balanced farm environment.

And for those who wish to observe the correct etiquette: a man should pluck a berry when he kisses a woman under the mistletoe, and when the last berry is gone, there should be no more kissing!

(Williams, n.d.)

The New England PIRD trials

Trials to control mistletoes in 'at-risk' trees were conducted on five properties in the New England using funding obtained through Meat & Livestock Australia's Producer Initiated Research & Development (PIRD) funding. At-risk trees were those trees with more than 70% of their canopy being mistletoes.

For more information on the experimental design and treatments of the New England PIRD trials and full presentation of the results, please see the report entitled "Results of Mistletoe Pruning and Pollarding Trials for Southern New England Landcare and Meat & Livestock Australia" by Nick Reid and Jim Fittler (2008).

The control and management strategies used were influenced by costs, which dictated the more traditional surgical and herbicidal approaches.

The photographs on page 12 illustrate treatments at the "Bannaweera"/"Springdale Park" site over the period of the trial. Twenty five Blakely's red gums were treated in March 2004, and then assessed two months later and 12 months later. A final assessment was made in June 2008, although those photographs are not included here.

Bannaweera/ Springdale Park

	Before treatment	2 months after treatment	12 months after treatment
Control			
One-third prune			
Two-thirds prune			
Complete prune			
Pollard			

Cost of control

The cost of lopping mistletoes on the trial properties was based on a rate of $1.83 per minute (or $110 per hour) for an arborist to climb the trees and lop mistletoes using specialist equipment.

The average cost of lopping 5 trees per treatment at two of the properties is shown in Table 1.

Table 1: The average cost of lopping 5 trees per treatment at "Kyabra" and "Bannaweera"/"Springdale Park"

Treatment	Kyabra (stringybarks)	Bannaweera/ Springdale Park (red gums)
One-third prune	$9.15	$24.52
Two-thirds prune	$17.93	$30.74
Complete prune	$60.39	$93.33
Pollard at 3 m height	$8.78	$13.18

Results at a glance

In order to save trees at risk from death caused by mistletoe infestation, they must be treated before they reach the 90% infestation level, otherwise they are likely to die anyway.

Responses to pruning

There are measurable improvements in the health of at-risk trees by pruning some of the mistletoes from those trees during 'normal' seasonal conditions.

In general, the more mistletoe pruned, the better the response in the tree and the longer the impact is sustained: the complete prune produced the best response in at-risk trees, while a two-thirds prune produced the next best response. Over all five properties, a one-third prune produced no significant difference in response when compared with the experimental control, after four years. Figure1 shows these responses graphically.

Note that there were no tree health benefits from partial pruning during a drought and insect attack after pruning caused poor results. Rather, it is recommended to prune trees when they are in good health and defoliating insect pressure is likely to be low.

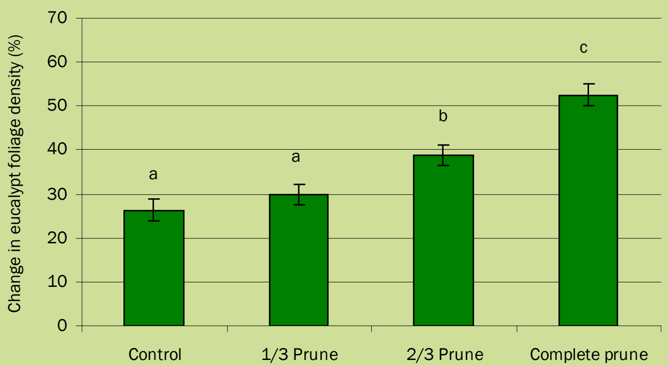

Figure 1. The change in eucalypt foliage density (%) with different treatments of mistletoe over the life of the experiment (4 years). Letters indicate statistical differences.

Responses to pollarding

Pollarding was cost- and time-effective, and was most successful when performed in spring on trees with medium mistletoe infestation levels (less than 75%).

Pollarding resulted in 28% mortality among trees. Pollarding during autumn is not recommended, nor is pollarding heavily infested trees (i.e. greater than 75% mistletoe infestation level), due to greater losses under these conditions (Figure 2).

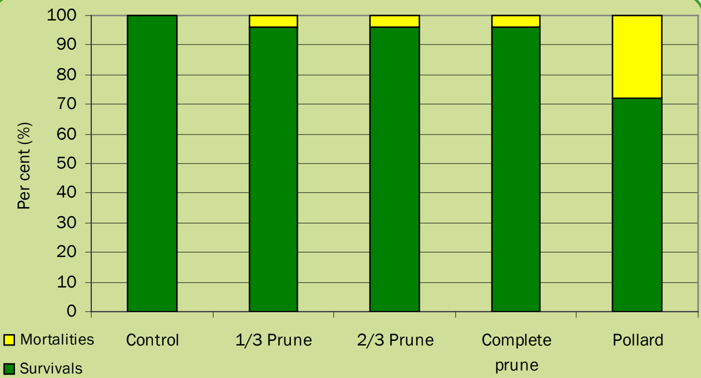

Figure 2. The percentage survival and mortality of trees treated using the different methods after 4 years.

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